costless water, the *actual* selling-price is ($\frac{10}{9}$ of $\frac{125}{100}$) of $100\% = 138\frac{8}{9}\%$. Hence, the actual rate per cent. of profit is $38\frac{8}{9}\%$.

II. Solution by FRANK HORN, Columbia, Missouri, and Professor H. J. GAERTNER, Wilmington College, Wilmington, Ohio.

II.
1. 100% = apparent value.
2. 125% = selling price of apparent value.
3. $90\% = 100\% - 10\%$ = value of quantity sold for 125%.
4. $\therefore$ $\frac{125}{90}\%$ = what 1% sells for.
5. $138\frac{8}{9}\% = 100 \times \frac{125}{90}\%$ = real selling price.
6. 100% = true value.
7. $38\frac{8}{9}\% = 138\frac{8}{9}\% - 100\%$ = rate of gain.

$\therefore$ The actual rate of gain is $38\frac{8}{9}\%$.

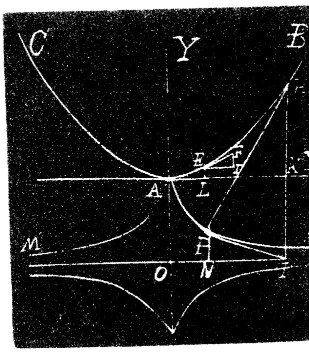
34. A chain 100m long, weighing 14 oz. to the foot, is suspended from points on a level 80m apart. What is the sag, the batter at the ends, and the horizontal tension? [From *Wentworth & Hill's High School Arithmetic.*]

Solution by B. F. FINKEL, A. M., Professor of Mathematics and Physics in Kidder Institute, Kidder, Missouri.

The form of the chain fulfilling the conditions of the problem is the curve known as the *catenary*. Let B and C be the points of suspension of the chain, E any point in the chain, $AL=x$, $EL=y$.

Let $AE=s$ and $w=45.93$oz. the weight of a metre of length of the chain.

Then ws = the weight of the portion AE = the load suspended at E, or the vertical tension at E. Let aw = the horizontal tension at A, the weight of a units of length. Let EF be a tangent at E; then if EF represents the tension at E, EI and IF will represent the horizontal and vertical tensions respectively, at E.



Hence, $\dfrac{dy}{dx} = \dfrac{FI}{EI} = \dfrac{ws}{wa} = \dfrac{s}{a}$....(1). But $ds = \sqrt{(dy^2 + dx^2)}$. $\therefore$ $dy = \sqrt{(ds^2 - dx^2)}$.

$s / a = \sqrt{(ds^2 - dx^2)} / dx$, whence

$$\frac{dx}{ds} = \frac{a}{\sqrt{(a^2+s^2)}}. \quad \therefore \quad x = a\int\frac{ds}{\sqrt{(a^2+s^2)}}$$

$= a \log_e (s + \sqrt{a^2+s^2}) + c$. Since $x=0$, when $s=0$, $c = -a \log a$.

$\therefore$ $x = a \log_e [(s + \sqrt{a^2+s^2}) / a]$....(2). From (2), we have

$s = \dfrac{a}{2}(e^{\frac{x}{a}} - e^{-\frac{x}{a}})$....(3). From (1) and (3) $\dfrac{dy}{dx} = \frac{1}{2}(e^{\frac{x}{a}} - e^{-\frac{x}{a}})$.

$\therefore$ $y = \dfrac{a}{2}(e^{\frac{x}{a}} - e^{-\frac{x}{a}}) + c$. Since $y=0$ when $x=0$, $c=-a$.

$\therefore$ $y = \dfrac{a}{2}(e^{\frac{x}{a}} - e^{-\frac{x}{a}}) - a$....(4). From (3) and (4) we get $a = (s^2 - y^2) / 2y$.

From (2), we easily get $x=a\log_e[(y+\sqrt{y^2-a^2})/a]=a\log_e[(s+\sqrt{s^2+a^2})/a]=(s^2-y^2)/2y\log[(s+y)/(s-y)]\div\log_{10}e$.

$\therefore \log x=\log(s+y)+\log(s-y)+\log[\log(s+y)-\log(s-y)]-\log y-\log[2\log_{10}e]$.

$=\log(s+y)+\log(s-y)+\log[\log(s+y)-\log(s-y)]+\text{colog}\, y+0.0612$.

From this equation, since $x=40$m and $s=50$m, we find, by the Method of Double Position, the value of $y=26.53$m which is called the sag.

The tension at $A=wa=w\left(\frac{s^2-y^2}{2y}\right)=1559.78$ oz., and $\frac{FI}{EI}=\frac{a}{s}$ $=.6797$ the *batter*.

From the above equations we may obtain the four propositions as given in Wentworth and Hill's High School Arithmetic.

35. Proposed by B. F. FINKEL, Professor of Mathematics in Kidder Institute, Kidder, Missouri.

Between Sing-Sing and Tarry-Town, I met my worthy friend, John Brown,
And seven daughters, riding nags, and every one had seven bags:
In every bag were thirty cats, and every cat had forty rats,
Besides a brood of fifty kittens. All *but* the nags were wearing mittens!
Mittens, kittens—cats, rats—bags, nags—Browns,
How many were met between the towns?

[From *Mattoon's Common Arithmetic.*]

Solution by FRANK HORN, Columbia, Missouri.

II.
1. $8=$ number of Browns met.
2. $8=8\times1=$ number of nags.
3. $56=8\times7=$ number of bags.
4. $1680=30\times56=$ number of cats.
5. $67200=1680\times40=$ number of rats.
6. $84000=1680\times50=$ number of kittens.
7. $167888=$ Browns + cats + rats + kittens.
8. $335776=167888\times2=$ number of mittens worn provided that each person, cat, rat, and kitten wore one pair.
9. $636616=$ Browns + nags + bags + cats + rats + mittens + kittens.

III. $\therefore$ The number of objects and persons met amounted to 636616.

NOTE.—The result given in Mattoon's Arithmetic is 2184192. What interpretation did Mr. Mattoon give to the problem?—EDITOR.

PROBLEMS.

42. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

If $m=2$ct. be the interest on $M=100$ct. for $p=10$ days, find the yearly rate per cent.

43. Proposed by B. F. BURLESON, Oneida Castle, New York.

A, in a scuffle, seized on $\frac{2}{3}$ of a parcel of sugar plums; B caught $\frac{3}{8}$ of it out of his hands, and C laid hold on $\frac{3}{10}$ more; D ran off with all A had left, except $\frac{1}{7}$ which E afterwards secured slyly for himself; then A and C jointly